09/831664
Rec'd PCT/PTO 11 MAY 2001
WO 00/28256 4/PRTS PCT/AU99/00994

TUBE SECTION HAVING ACCESS OPENING AND METHOD OF FORMING THE TUBE SECTION

This invention relates to a tube section having an access opening and to a method of making the tube section. The tube section may form a pipeline or conduit or be coupled in a pipeline or conduit so as to provide access into the pipeline or conduit.

Pipelines and conduits are commonly used in a large variety of industries, such as those requiring gas and liquid pipelines (ie petrochemical installations), static solid pipelines (ie for containing cables) such as may be required in aircraft and submarines. Examples of such pipelines and conduits include those made from metals such as stainless steel, plastic or glass.

Applications in which such pipelines and conduits are used include conduit for electrical cable such as in factories for supplying electrical power or data to machines. Such conduit typically extends throughout the factory and carries the electrical cable for powering and controlling the machines. At various points along the length of the conduit it is necessary for the electrical cable to exit the conduit and to be directed to the machine which is to be powered or controlled. The insertion of electrical cable into conduits is simple, merely requiring the cable to be inserted through one end of the pipeline or conduit. However, the ability to extract the cable at various points along the conduit is somewhat more difficult and usually involves special junction boxes which enable access to the conduit so that the cable can be directed out of the conduit through a hole in a junction box and down to the particular machine concerned.

Other applications for pipelines and conduits include those for conveying fluids and particulate materials such as

powder. The conveying of some fluids, in particular, viscous liquids and powder materials such as powdered milk are subject to blockage and therefore access to the interior of the pipeline or conduit is required in order to clear the blockage.

Some access openings in pipelines and conduits involve ports or the like in the pipeline or conduit which extend into the conduit. The ports involve components which can project into the interior of the central passageway defined by the pipeline or conduit which provides a baffle against which material can gather. The gathering material can increase the likelihood of blockage of the pipeline.

The need to provide junction boxes in electrical cable conduit, so that the cable can be directed from the pipeline to a machine also involves additional problems in some environments. For example, in environments where powder, such as powdered milk, is being processed or manufactured, the box generally provides a flat surface upon which powder can build up. Any moisture in the air can contact the powder causing the powder to moisten and therefore to provide an environment in which bacteria can readily grow. Obviously, this is of considerable disadvantage in environments in which food products are processed and manufactured.

The object of the present invention is to provide a tube section which can form a pipeline or conduit or be coupled in a pipeline or conduit which overcome the above disadvantages.

The invention, in a first aspect, may be said to reside in a tube section for forming a pipeline or conduit or for coupling in a pipeline or conduit, including:

a tube wall defining a central passageway, the tube wall having an internal surface;

a cutout, cut from the tube wall and leaving an opening through the tube wall, the cutout having a side edge and the opening having a mating side edge which are formed when the cutout is cut from the tube wall, the cutout having an internal surface; and

the side edges of the opening and cutout defining abutting ledges so the cutout can be inserted in the opening with at least a portion of the side edge being supported against at least a portion of the side edge of the opening so the cutout forms a removable access cover with the internal surface of the cutout substantially flush with the internal surface of the tube wall when the cutout is installed in the opening.

Thus, according to this aspect of the invention, an access opening is provided which can provide access to the interior of a pipeline or conduit formed from the tube section or at which the tube section is coupled so as to enable electrical conduit to be redirected from the pipeline or conduit or the interior of the pipeline or conduit to be inspected for maintenance or clearance or blockages. If the pipeline or conduit is carrying fluid or particulate material. Supported on the side edge of the oval opening and as an interior surface which is flush with the interior surface of the tube wall, no projections extend into the central passageway which can provide a baffle upon which material can collect to increase the likelihood of a blockage. Thus, the access opening formed by the oval cutout enables access to the interior of a pipeline or conduit for redirecting electrical cables out of the pipeline or conduit at particular points or enabling maintenance to take place by way of clearing of blockages or otherwise inspecting the interior of the pipeline or conduit.

In one preferred embodiment of the invention, the cutout is sealed in place on the opening by a sheet member having an

adhesive applied to one surface so that the sheet member can be adhered adjacent to and over the side edges when the cutout is in place in the oval opening.

Preferably the sheet member comprises a rectangular piece of acrylic material having adhesive applied to one side. However, the sheet member could be formed in shapes other than rectangular, such as oval, circular or the like.

Preferably the sheet material is formed from acrylic material and is transparent. However, the material from which the sheet is formed may be different depending on the environment intended for the tube section. Preferably the sheet material is able to be printed upon.

Preferably the side edges have a predetermined constant angle with respect to a line tangential to the tube wall at each point along the side edges.

In one embodiment of the invention, the predetermined angle is an angle of 90°. However, in other embodiments of the invention, the angle may be an obtuse angle of from, for example, 100° to 130°. In these embodiments the cutout is intended to be located on the side edge of the opening from exterior of the tube section and supported on the side edge of the opening so that the cutout will not move inwardly of the tube section into the central passageway.

However, in other embodiments, the predetermined angle could be an acute angle, of for example from 50° to 80°, so that the cutout is intended to be inserted in place against the side edge of the cutout from the central passageway within the tube section so as to be held against movement outwardly with respect to the tube wall.

The invention may also be said to reside in a method of forming an access cover in a tube section for forming a

pipeline or conduit, or for coupling in a pipeline or conduit, said method including:

moving the tube section relative to a cutting tool so that the cutting tool and tube section are moved relative to one another to cut a cutout from the tube section to leave an opening in the tube section with the cutout having a side edge and the opening having a side edge which are formed when the cutout is cut from the tube wall; and

wherein the cutout forms the access cover which can be removed from and replaced in the opening with the side edge of the opening engaging the side edge of the cutout so that the access opening can be supported on the cutout without projecting into the central passageway so as to have an interior surface which is substantially flush with the interior surface of the tube wall.

In one preferred embodiment of the invention, the cutout is sealed in place on the opening by a sheet member having an adhesive applied to one surface so that the sheet member can be adhered adjacent to and over the side edges when the cutout is in place in the oval opening.

Preferably the sheet member comprises a rectangular piece of acrylic material having adhesive applied to one side. However, the sheet member could be formed in shapes other than rectangular, such as oval, circular or the like.

Preferably the sheet material is formed from acrylic material and is transparent.

Preferably the step of moving the tube section relative to the cutting tool comprises the steps of moving the cutting tool relative to the tube in a plane and rotating the tube section about a longitudinal access of the tube section relative to the cutting tool.

Preferably the movement in the plane and the rotation is controlled by a central processor.

Preferably the cutting tool is a laser cutting tool.

A further aspect of the invention may be said to reside in a method of gaining access to and resealing a tube section for forming a pipeline or conduit or for coupling a pipeline or conduit wherein the tube section has a tube wall defining a central passageway and a cutout cut from the tube wall forming an opening through the tube wall, the cutout having a side edge and the opening having a side edge which are engageable with one another to locate the cutout in the opening to cover the opening, the method including:

locating the cutout in the opening so that the side edge of the cutout engages the side edge of the opening;

locating a sealing sheet having adhesive on one side over the abutting side edges so that the adhesive adheres to the tube wall and cutout adjacent the abutting side edges and over the abutting side edges to seal the cutout in the opening; and

whereby access to the pipeline or conduit can be provided by peeling the sheet member from the tube wall and cutout and removing the cutout from the opening.

In the preferred embodiment of the invention, the tube section is circular in transverse cross-section.

Preferably the sheet member comprises a transparent adhesive back acrylic sheet.

In one embodiment of the invention, the acrylic sheet covers the entire cutout and adjacent portions of the tube wall when sealing the cutout in the opening.

However, in some embodiments, the sheet material may have a central aperture so as to cover the tube wall and cutout adjacent the abutting side edges but leaving a mid portion of the cutout exposed.

In one embodiment the cutout and opening are oval when viewed in plan. However, other shapes, such as rectangular with rounded corners are also possible.

Preferred embodiments of the invention will be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a plan view of a tube section according to the preferred embodiment of the invention;

Figure 2 shows an apparatus and method for forming the tube section of Figure 1;

Figure 3 is a side view of the tube section of Figure 1 with an access cover removed;

Figure 4 is a view along the line L-L of Figure 1 with the access cover slightly raised for illustrative purposes according to one embodiment of the invention;

Figure 5 is a view similar to Figure 4 of another embodiment;

Figure 6 is a view similar to Figure 4 according to a further embodiment;

Figure 7 is a view along the line L1-L1 of Figure 3 corresponding to the embodiment of Figure 4;

Figure 8 is a view along the line L1-L1 of Figure 3 corresponding to the embodiment of Figure 5;

Figure 9 is a view along the line L1-L1 of Figure 3 corresponding to the embodiment of Figure 6;

Figure 10 shows a sealing sheet member according to one embodiment of the invention;

Figure 11 is a cross-sectional view showing the sealing sheet member of Figure 10 in place; and

Figure 12 is a perspective view of another embodiment of the invention.

With reference to Figure 1, a tube section 10 is shown which is circular in transverse cross-section and of any desired length. According to the most preferred embodiments of the invention, the tube section 10 is between about 200 mm and 900 mm in length forming a tube section for coupling (such as by welding, gluing or other joining method) into a pipeline or conduit. However, in other embodiments, the tube section 10 could be of sufficient length to form the entire conduit or pipeline itself. The tube section 10 has an access opening 12 which is covered by an access cover 14 and a cylindrical wall 11. The wall 11 defines a hollow circular passage through the tube section 10 for enabling material to flow through the tube section 10 or enabling electrical cables or the like to be passed through the tube section 10. The access cover 14 is cut from the tube section 10 by making a cut through wall 11 which defines the tube section 10.

The ends 13 and 15 of the tube section 10 are open and can abut the ends of pipes (not shown) and be welded to the pipes.

In the most preferred forms of the invention, the tube section 10 is of a length between 200 mm and 900 mm and is intended to be joined into the pipeline by welding as the pipeline is installed in a factory or the like. The access cover 14 provides access to the tube section 10 so that access to the interior of the tube section 10 and therefore the interior of the pipeline or conduit with which the tube section 10 is coupled can be obtained.

The access opening 14 is cut from the tube section 10 preferably by a laser cutting operation along a cut line from point A, to point B, to point C and then to point D and back to point A to form the cutout 14 which is cut completely from the tube section 10 to provide the axis

opening 12.

As best shown in Figure 1, in plan, the access opening 12 and cutout 14 are oval with the major access of the oval shape being parallel to the longitudinal access of the tube section.

The cutout 14 which forms the access cover is cut from the tube section 10 in the manner shown in Figure 2 by a laser cutting operation.

With reference to Figure 2, a laser cutting machine has a laser head schematically shown at 20 which is formed on a cross-member 22. The cross-member 22 is adapted to be moved in a Y-axis in an east-west direction as shown in Figure 2. A bed 24 is arranged beneath the beam 22 and is intended for movement along an X-axis in a north-south direction as also shown in Figure 2. Mounted on the bed 24 is a fixture 26 within which the tube section 10 can be inserted for rotating the tube section 10 in a Z direction about the longitudinal axis of the tube section 10.

The movement of the beam 22, the bed 24 and rotation of the tube 10 takes place under the control of a microprocessor controller 30 which forms part of the cutting machine. The controller 30 controls the movement so that the laser cutting head 20 is moved relative to the tube section 10 along the path A, B, C and D and then back to A as described with reference to Figure 1. By controlling the movement in the X-axis, Y-axis and Z-axis directions, a cut can be formed through the tube wall 11 so as to cut the cutout 14 from the wall 11 of the tube section 10.

Figure 3 shows the cutout 14 removed from the tube section 10 to expose the opening 12. The opening 12 and the tube section 14 will be defined by side edges 40 and 50 respectively which are best shown in Figure 3. Side edges

40 and 50 as is apparent from a consideration of Figures 1 and 3 are continuous oval edge extending about the periphery of the opening 12 and the cutout 14. By suitably controlling the cutting operation described with reference to Figure 2, the side edges 40 and 50 can be cut at a predetermined angle with respect to a tangential line, represented by the line 60 in Figures 3 to 9, at each point along the side edges 40 and 50. In the embodiment of Figures 4 and 7, the prescribed angle with respect to the line 60 is 90° as shown by the angle θ shown in Figures 4 and 7.

Figures 5 and 8 show an example where the angle θ1 between the side edge 40 and the line 60 is an obtuse angle of, for example, between 100° and 130°. Figures 5 and 9 show an example where the angle θ2 between the side edge 40 and the line 60 is an acute angle of from, for example 60° to 80°.

In the embodiment of Figures 6 and 9, it is intended that the cutout 14 be manipulated through the access opening 12 and then lifted into position so that the side edge 50 seats against the side edge 40 from within the interior of the tube section 10.

During the movement of the tube section 10 relative to the cutting head 20 shown in Figure 2, the angle of the cut remains the same so that the edge 40 and edge 50 are always at the same angle relative to the tangential line 60 at each point about the entire periphery of the cutout 14 and opening 12 for each respective embodiment.

In the most preferred embodiment shown in Figure 4 at which the angle is intended to be 90°, it appears from the cross-sectional view in Figure 4 that the cover 14 could fall straight through the access opening 12. However, as is apparent from a consideration of Figure 7 which shows a cross-section along the line L1-L1, it is apparent that the

side edge 50 and side edge 40 will abut one another without the lid 14 falling straight through the access opening 12.

Thus, it will be apparent from a consideration of Figures 3 to 9 that when the cutout 14 is located back in place in the opening 12, the edge 50 will abut and mate with the edge 40 so that an interior surface portion 14a of the cutout 14 is flush with the interior surface 11a of the pipe section 10. Thus, no part of the cutout 14 which forms the access cover protrudes into the tube section 10.

Figure 10 shows a cover sheet 70 according to the preferred embodiment of the invention. The cover sheet 70 is preferably formed from transparent acrylic material and has an adhesive layer applied to surface 72 which may be covered by a peel-off paper sheet 74. In order to seal the cutout 14 in place, the cutout 14 is located in the access opening 12 so that the side edge 50 abuts the side edge 40. The backing sheet 74 is removed from the sheet 70 to expose the adhesive layer 72 and the backing sheet 70 is then provided over the cutout 14 as best shown in Figure 11 so as to completely cover the cutout 14 and adjacent portions of the tube wall 11. Thus, the cutout 14 is held in place by the sheet 70 which, together with the abutting side edges 40 and 50, forms a seal to prevent escape of fluid through the pipeline or conduit. In order to gain access to the pipeline or conduit, the sheet 70 is simply peeled off the pipe section 10 to expose the cover 12 and the cover 12 may be removed so that access to the pipeline can be obtained through the opening 12.

Access to the pipeline can be required in order to locate electrical conduit and pass the electrical conduit from the pipe section 10 through, for example, an outlet boss 90 shown in Figure 3 so a particular wire can be redirected down out of the pipeline (through a conduit (not shown) attached and sealed to the boss 90) to a machine for

powering or controlling the machine.

In a typical installation, a number of the tube sections 10 may be provided along a pipeline or conduit at distances of, for example, ten feet or the like so as to provide several points along a pipeline or conduit to which access can be obtained for clearing blockages or otherwise inspecting the interior of the pipeline or conduit or enabling cable to be threaded from the pipeline or conduit down to a machine.

Preferably the adhesive layer on the backing sheet 72 is a permanent type adhesive which nevertheless enables the acrylic sheet 70 to be peeled off the tube section 10 when it is necessary to gain access to the cutout 14. The acrylic sheet 70 is not intended to be reused and when it is desired to reseal the cutout 14 in place, a new sheet 70 is applied to the cutout 14 and tube section 10.

The embodiment shown in Figures 6 and 9 is particularly adapted for use with pipelines or conduits which are intended to convey pressurised fluids. The pressure in the pipeline will obviously force the cover 14 outwardly in the direction of arrow M thereby pushing the side edge 50 hard against the side edge 40 to assist in locating the cutout 14 in place.

In the embodiment of Figures 6 and 9, the cutout 14 can be provided with a handle 72 (see Figure 12) for assisting in manipulating the cutout 14 through the opening 12 into the interior of the pipe and then seating the edge 50 against the edge 40. In embodiments where a handle 72 is included, the cover sheet 70 can be provided with a central hole 74 as shown in Figure 12 so that the sheet 70 does not cover the entire cutout 14 and the portion of the wall 11 adjacent the cutout 12 but merely part of the cutout 14 thereby not interfering with the handle 72 and ensuring a

good bonding of the sheet 70 onto the cutout 14 and tube wall 11. The cover sheet 70 in the embodiment of Figures 6 and 12 will also assist in holding the cutout 14 in place within the opening 12 until pressure builds up in the pipe.

Alternatively, the arrangement shown in Figures 4 and 5 could also be used in pressurised situations although depending on the pressure within the pipe, it may be advantageous to locate a clamp about the outer periphery of the sealing sheet to assist in firmly holding the cutout 14 in place in the opening.

Since modifications within the spirit and scope of the invention may readily be effected by persons skilled within the art, it is to be understood that this invention is not limited to the particular embodiments described by way of example hereinabove.